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AREA 1, PHASE I PRAIRIE GRASS ESTABLISHMENT STUDY

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

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Abstract:

In its second year, the Prairie Grass Establishment Study continued measurement of prairie grass establishment and performance on a series of experimental plots to evaluate the suitability of various soil amendment and mulch combinations, seeding methods and management practices for establishing tall grass prairie. The original *5 by 3 plot design* was used to study the effects of augmenting low organic content of the disturbed areas by applying combinations of soil amendments and addressing the lack of cover by applying mulches on prairie. Evaluation of the establishment and growth in plots after the first season prompted us to consider re-planting some of them to obtain more reliable seeding and to reduce weediness. In particular we were seeking a mulch that would not introduce a large number of weeds as the straw appeared to do. The original *five by three design*, which gave 15 combinations in triplicate for a total of 45 plots was modified in the fall of 1998. A total of 17 of the original plots covering the spectrum of amendments was continued and the remaining 28 plots were re-planted. Wood chips were added to the plots to be replanted and 15 were planted with the seed mix by Truax seed drill and 13 were planted by hand broadcasting.

Early in the summer the weediness of the plots was evaluated. The measured parameters were analyzed in terms of the amendments used and the mulch applied. At intervals after planting, germination success, the cover of the seeded grasses and prevalence of weeds were surveyed. At the end of the second season the 17 original plots and 28 replanted plots were evaluated by collecting the prairie grasses, making stem counts of each of the 5 species for each plot and measuring biomass for each. The experience with two seasons of growth of the prairie grasses in the experimental plots has produced a number of conclusions and recommendations. Evaluation can be considered to be reliable only after several seasons, especially when planting on disturbed soils. Amendments that enhance soil organic matter increased growth but not enough to justify their routine use in establishing prairies. Wood chip mulch provides a barrier to weed establishment while slowly contributing to soil organic matter and water-holding capacity and should be considered when establishing prairies on disturbed sites. It is important to gain experience managing weeds by timely mowing. Finally it is important not to introduce weeds by amendments and to allow time for killing the weeds prior to planting.

Objectives:

The Prairie Grass Establishment Study will identify methods for establishing and managing prairie vegetation on sites that have had top soil removed as part of remediation at the Fernald Environmental Management Project site. Native prairie grasses studied included Canada Wild Rye (*Elymus canadensis*); Little Bluestem (*Schizachrium scoparius*); Big Bluestem (*Andropogon gerardii*); Indian Grass (*Sorghastrum nutans*);) and Side Oats Grama (*Bouteloua curtipendula*).

Rationale for Second Year (1999) Activities:

Measurements of establishment and growth of prairie grass on the 45 experimental plots with the 3 by 5 plot design made in Fall 1998 revealed low levels of prairie grass establishment and high levels of weediness on many of the plots planted in the Spring of 1998. The weediness was attributed to the straw mulch and the poor establishment to uneven seeding due to clogging of the seed drill delivery tubes. We decided to discontinue the plot design of 5 amendment treatments by 3 mulch treatments and re-plant 28 of the failed plots. The 17 plots with the best performance, which are shown in **Figure 1** (grouped by amendment) and **Figure 2** (grouped by mulch), were continued. These plots provided data for evaluating establishment and growth of the prairie grasses after 2 seasons. The plot numbers in these figures correspond to those shown on the original map for the Spring 1998 plantings (**Figure 3**).

In the fall of 1998 wood chips were spread on the plots to be replanted so that the ***28 marginal plots*** had wood chip mulch (except for 6 that are designated N... #s 34, 37, 38, 40, 41, and 43). The wood chips weathered until the plots were planted in Spring 1999. Plots were sprayed with Roundup in early spring before the prairie grasses emerged to control the weeds observed in the previous year and were re-planted either by Truax seed drill (***15 plots***, #s 31 to 45) or by broadcasting of seeds (***13 plots*** #s 1, 2, 4, 5, 8, 11, 14, 17, 20, 22, 23, 26, and 29). A seed mix consisting of **Canada wild rye** (*Elymus canadensis)*; **little bluestem** (*Schizachyrium scoparius*); **big bluestem** (*Andropogon gerardii*); **Indian grass** (*Sorghastrum nutans*); and **side oats grama grass** (*Bouteloua curtipendula*) was planted at a rate of 15 lbs pure live seed/ acre. The remaining ***17 plots*** (#s 3, 6, 7, 9, 10, 12, 13, 15, 16, 18, 19, 21, 24, 25, 27, 28, 30) were undisturbed in order to examine the success of the first season planting and the progress of the prairie grass after 2 seasons (**Figures 1** and **2**).

The newly seeded plots were given a preliminary evaluation in Fall 1999 (**Figure 4** seed drill and **Figure 5** broadcast, both grouped by amendment) and will be measured in detail in Fall 2000 to determine the level of success. It is hoped that these plots will demonstrate the level of establishment and biomass production after the second season for seeds planted by a properly functioning seed drill or hand broadcast in wood chip mulch.

Plot Monitoring and Data Collection:

Monitoring during the growing season - The plots were monitored throughout the growing season to examine the level of weediness on each plot and recommend appropriate management. Problem weeds included Johnson-grass (*Sorghum halepense)*, common ragweed (*Ambrosia artimesiifolia)*, asters (*Aster* spp), Barnyard grass (*Echinochloa crus-galli)* and foxtail (*Setaria sp.)* The weediness of individual plots was monitored in June, July August and September. Management decisions were made based on the observations.

Weed control - Weed control included mowing to a 6-inch height and spot wipe application of Roundup® by glove and bucket method, to Johnson-grass.

Growth data - Above-ground biomass of planted prairie grasses were collected from the entire plot for each of the 45 plots. Because of the patchiness of seeding by the drill and the resulting somewhat spotty establishment, samples were taken from the entire plot. Second year growth was selected for by sampling only the plants that were reproductive. Each of the 5 species of prairie grasses was ***collected separately, stems were counted and the plants dried for weighing***. (The processing of the large number of samples is still in progress and the final data for biomass will be reported in an Appendix to this Report about December 20, 1999.) Initially, biomass data were reported with a 3-point index with 3 being high. Stem count and biomass data in the figures were grouped by amendment: manure, composted sewage sludge, 2-inch topsoil, 4-inch topsoil, or none and by mulch- wood chips or none.

Seeding method - Data for the first season plots were analyzed for those plants established from broadcast seed and those seeded by Truax seed drill to compare the rate of establishment with the Truax seed drill and with broadcast seeding.

Results:

ORIGINAL 1998 PLOTS - Data from the 17 remaining original plots, grouped by amendment, are shown in **Figure 1**. The bar graphs show stem counts and biomass indices. Averages of values for biomass index and stem count for a given amendment group are shown in parentheses. Compost and manure have the highest values for stem count [465 and 360, respectively] and biomass class (2.8 and 2.7). After December 15, 1999 when the harvest is complete and the material dried we will report biomass weight data for each of the five prairie grass species and the total biomass data in tables and discuss the implications in an Appendix to the Report. These more quantitative data will give a detailed evaluation of performance.

Data for the 17 remaining original plots, grouped by mulch are shown in **Figure 2**. In terms of stem counts the none and wood chip groups seemed comparable [330 and 290, respectively] but the wood chip group consistently showed a higher biomass index (2.6 vs. 2.0 for none). By inspection the wood chip plots were clearly less weedy. Plots were also evaluated for weediness in June 1999 **(Figure 5)**. The degree of weediness was confirmed with photographs of the plots taken in October 1999. The Johnson grass was killed in August by wipe-application of Roundup so it does not appear in the photos but the common ragweed (*Ambrosia artemisiifolia*) shows up as dense clumps with somewhat purple foliage and yellow seed head spikes. The suppression of weeds by the wood chips is evident from the data in **Figure 5** and the comparison of the photos for these plots. Only plot 6 departs from this pattern, having a stand of common ragweed.

REPLANTED 1999 PLOTS - It is premature to evaluate the level of establishment and biomass on these plots since complete emergence is not expected until their second season in the summer of 2000. The stem count and biomass index data are shown in **Figures 4** and **5**. A preliminary analysis of ranking of amendment groups based on data averages shows:

amendment	stem counts	biomass index
manure	267	2.6
composted sewage sludge	105	1.7
2" topsoil	142	2.4
4" topsoil	180	1.8
none	150	2.4

These plots were taken out of the original trial because of excess weediness. The herbicidal treatment was not very effective in ridding the plots of weeds from the previous year of 1998 (**Figures 7** and **8**). Though they have a high degree of weediness, the wood chips seem to have suppressed the weeds to a significant extent.

Comparison of the stem count data from the plots that were re-planted by broadcasting with the count from the plots replanted by Truax drill shows that the latter produced a larger stand, an average of 191 stems (Truax Seed Drill) vs. 134 stems (broadcast seeding). These data need to be examined again for these plots after their second season in the year 2000.

Conclusions and Recommendations:

1) It is difficult to gain a clear picture of the success or the value of a given factor after one growing season. Evaluation is most reliable after several growing seasons, especially when planting is being done on disturbed soils.

2) Although manure and compost seem to increase the stem count and biomass somewhat, it seems that seeding can be done without these organic-amendments. The gain does not seem that large. Pending confirmation of biomass weights (future Appendix...December 1999) an organic-enriching amendment does not seem necessary for planting in the disturbed soil. An amendment of manure may be helpful in the case of disturbed soil with a very low organic content.

3) Wood chip mulch applied at a uniform 1" depth provides a number of advantages. It is a barrier for germination of weed seeds but the grass seeds are able to become established, particularly when they are drilled into the soil. It lowers soil nitrogen which also controls weed establishment and slowly contributes organic matter to the soil.

4) Timely mowing and spot application of Roundup have proven helpful in controlling weeds. Gain experience with weed management by timely mowing and spot application of Roundup to reduce competition that can crowd out or shade out prairie grasses.

5) It is important not to introduce weed seeds, for example, by way of sewage sludge or straw. Also, it is important to time the application of Roundup prior to planting to have the opportunity to verify that the application actually killed the weeds and provided a weed-free soil. A few weeds with a head start can lead to a major problem. Allow time prior to planting so that weeds can be killed and the clean state be verified.

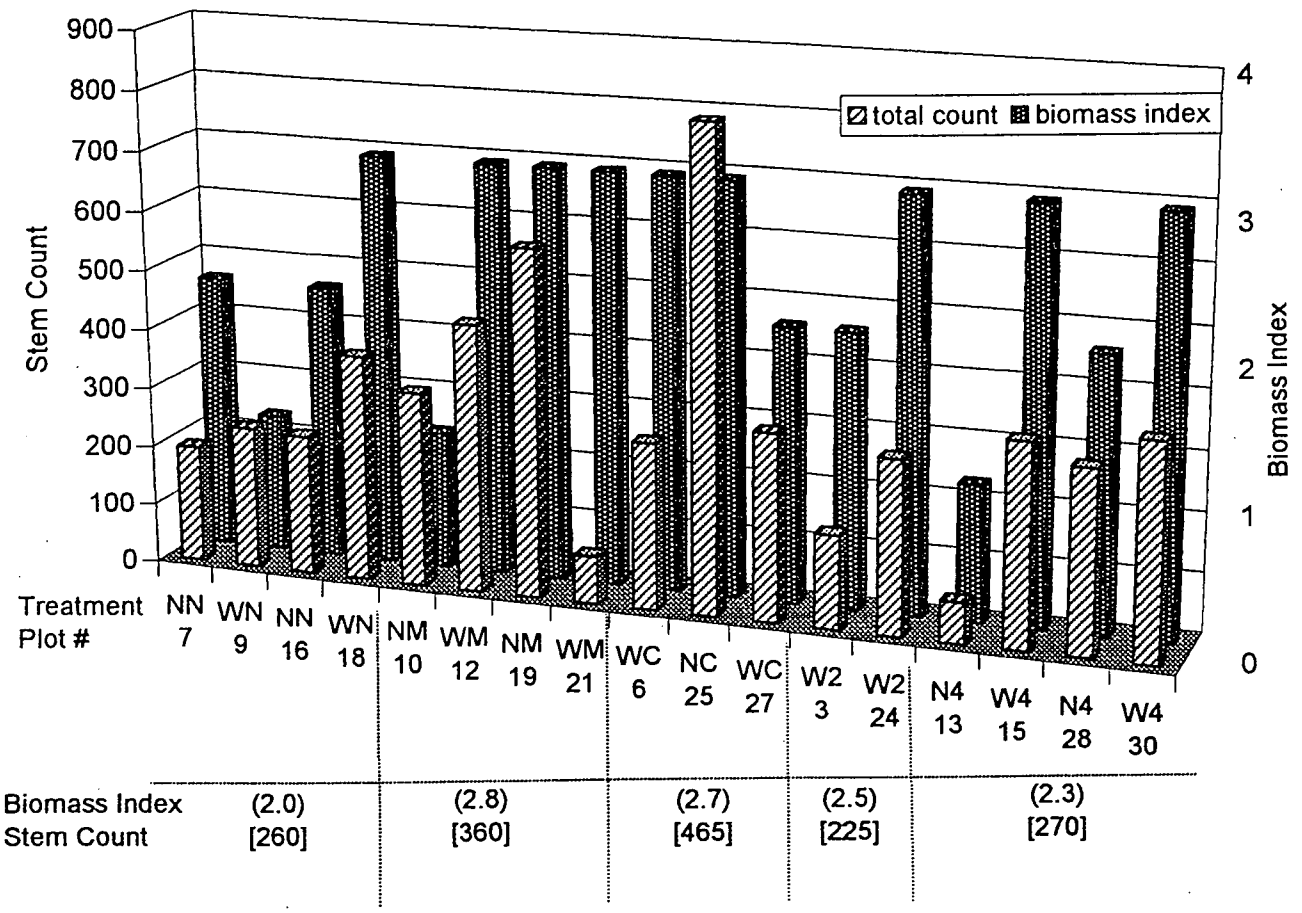


Figure 1. Stem counts and biomass index values for prairie grasses on the 17 remaining original plots measured after the 2nd growing season. Data are for plots grouped by amendment: **N-**: none, **M-**: manure, **C-**: composted sewage sludge, **2-**: 2" of topsoil, **4-**: 4" of topsoil. Mulch: **-N**: none, **-W**: wood chips. * represents original straw mulch, ^ represents original no mulch; (#): average biomass index for a group, [#]: average stem count for a group.

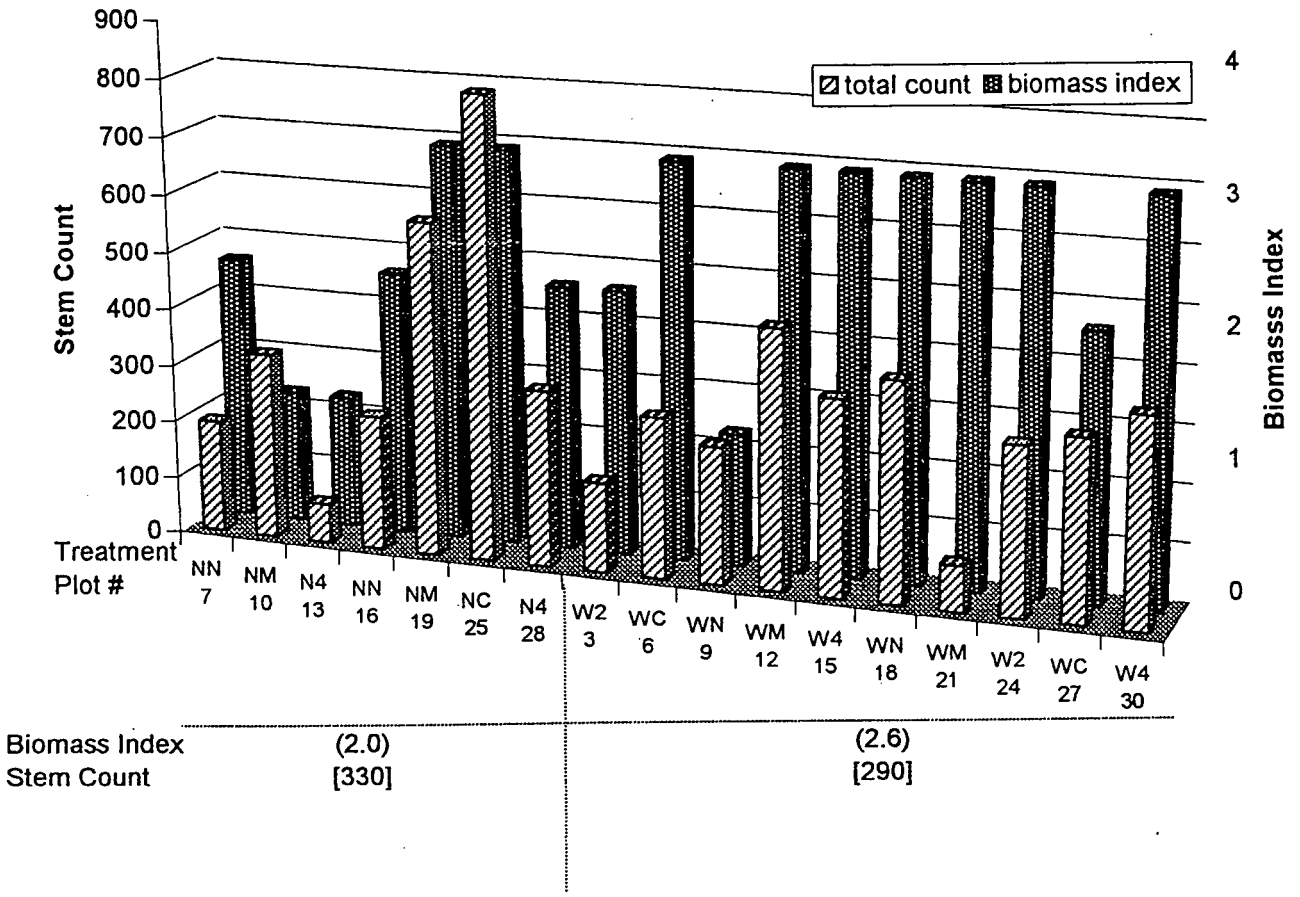
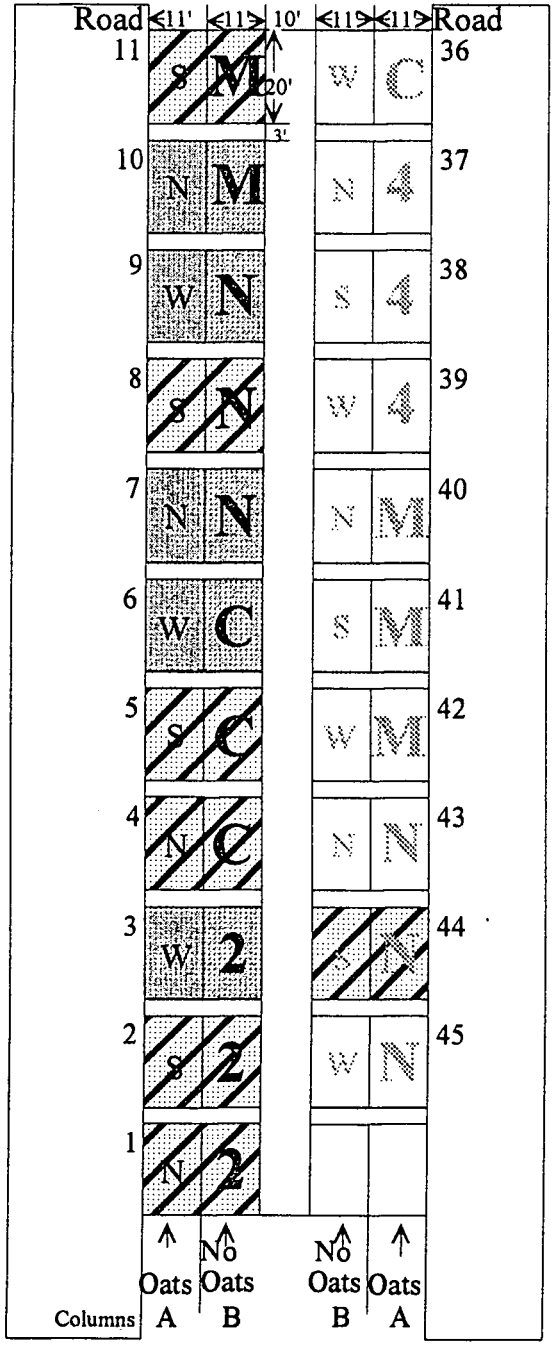


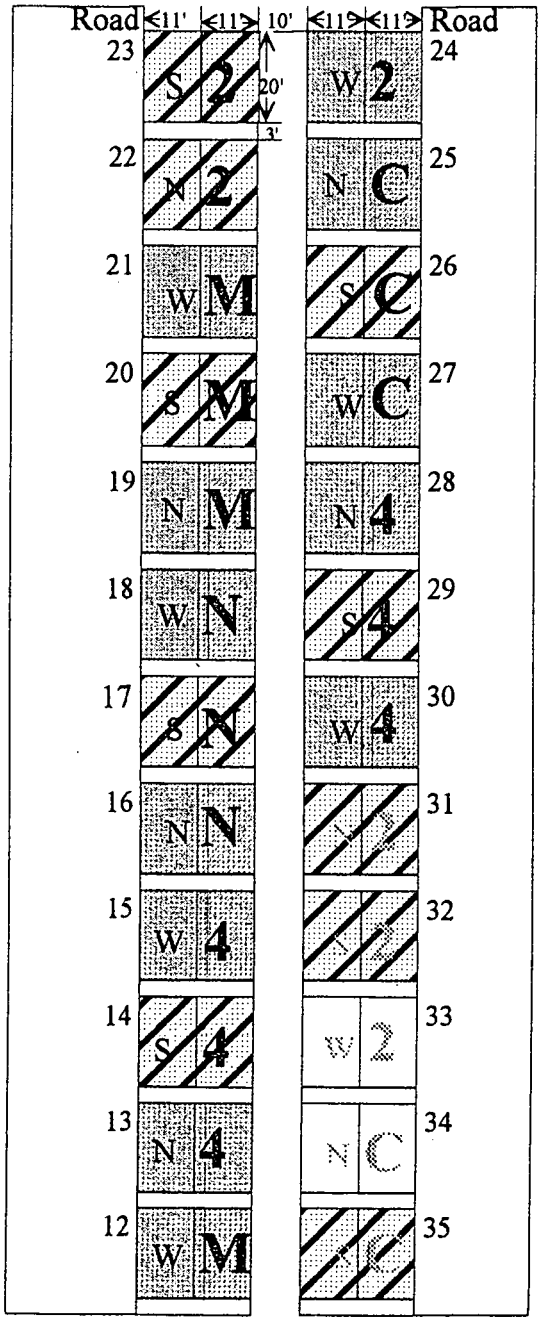
Figure 2. Stem counts and biomass index values for prairie grasses on the 17 remaining original plots measured after the 2nd growing season. Data are for plots grouped by mulch type. Legend as for **Figure 1**.

Figure 3:
Overall Summary:
Spring 1998, Truax 1999 and Wood Chips 1999



Southern End

Northern End



Legend

Amendments

- 2 — 2" soil cap
- 4 — 4" soil cap
- M — Manure incorp
- C — Sewage incorp
- N — None

Mulch

- N - none
- S - straw
- W - woodchips

All 45 original plots were drilled with Truax in spring 1998

17 of the original plots were allowed to stand unchanged

Or

Another 17 of the original plots received woodchips in fall 1998, **denoted by black hatching**

Gray lettering denotes Truax re-seeding of 15 plots in spring 1999

Black lettering with light shading denotes broadcast seeding of 13 plots in spring 1999

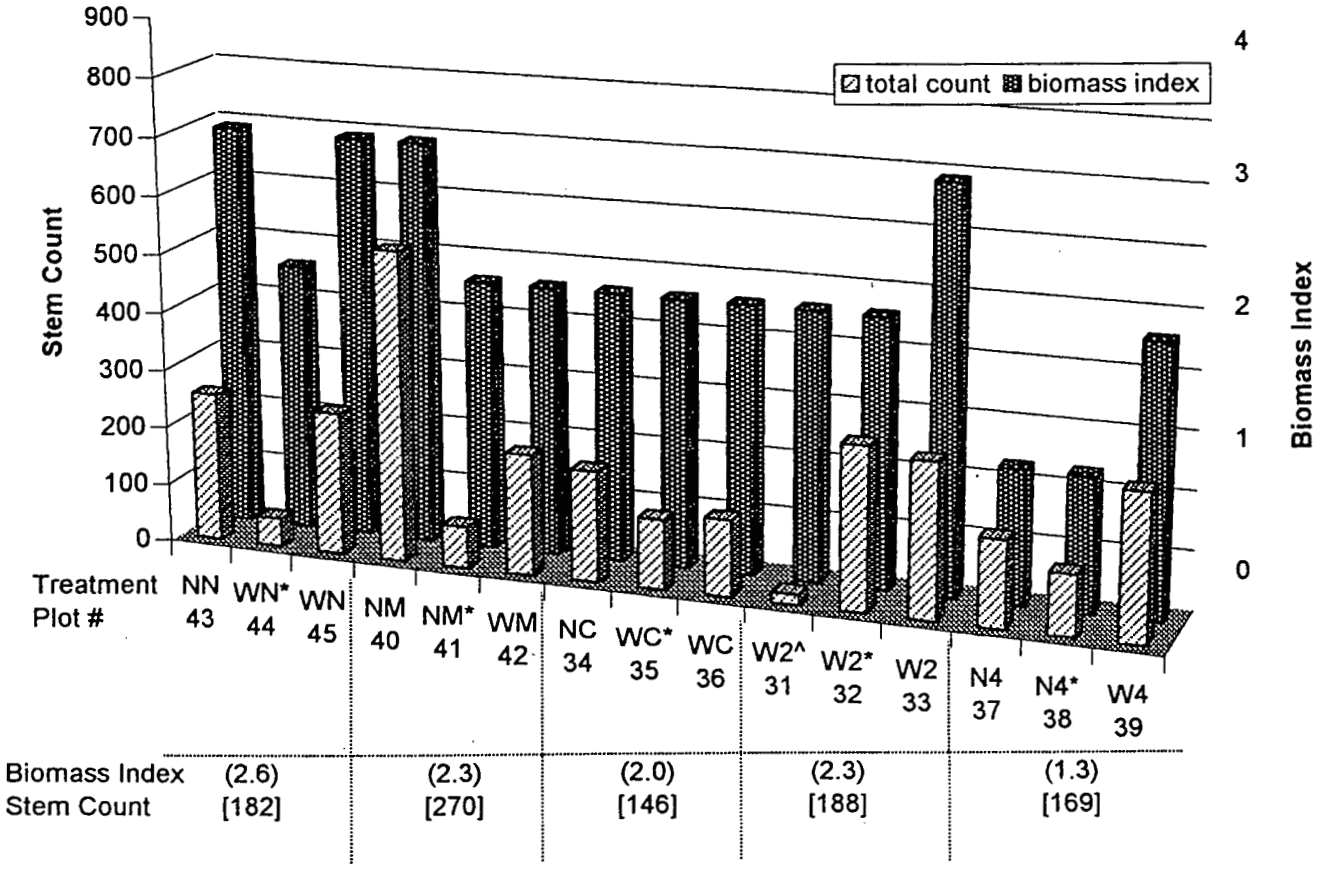


Figure 4. Stem counts and biomass index values for prairie grasses on the 15 plots replanted in spring 1999 by Truax seed drill. Data are for plots grouped by amendment. See **Figure 1** for legends.

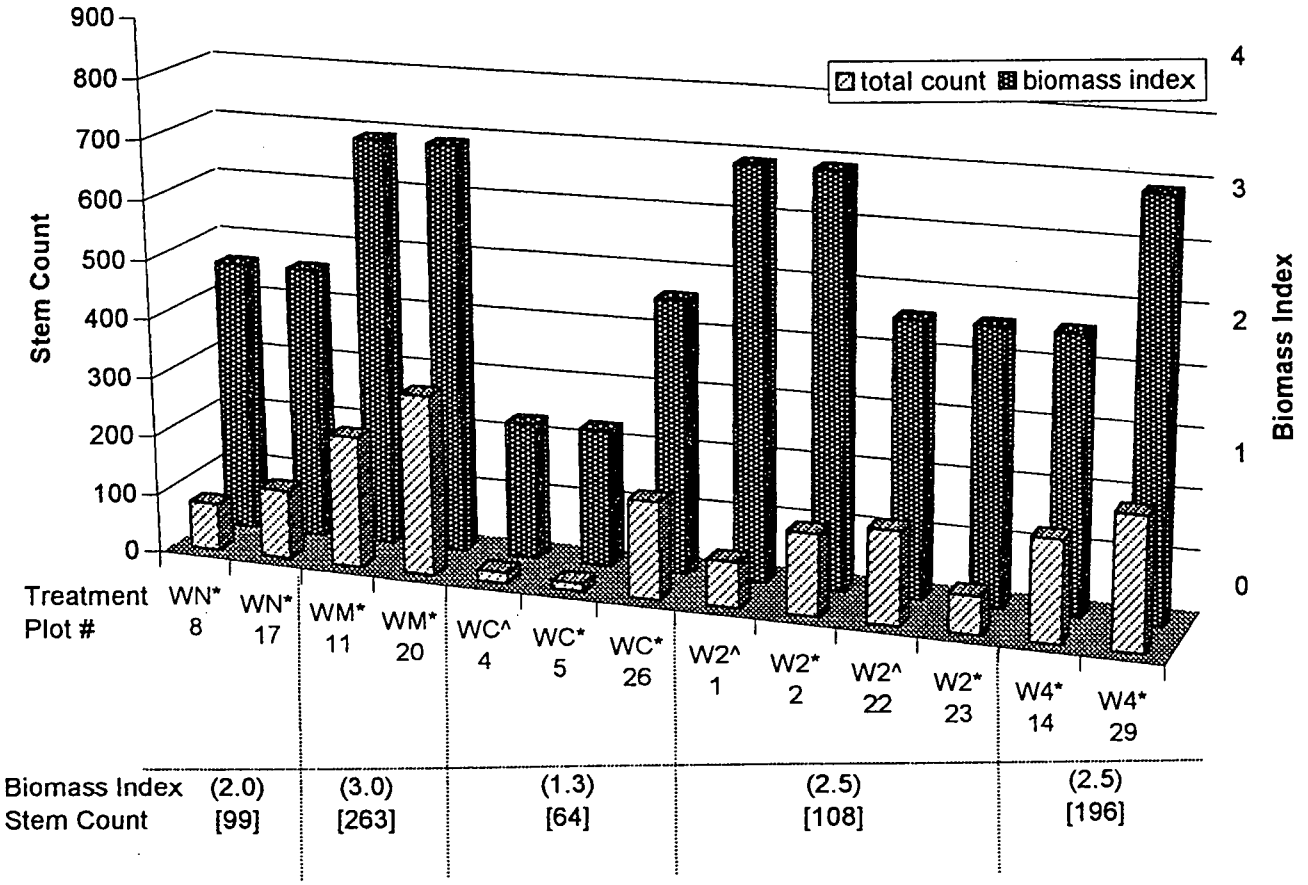


Figure 5. Stem counts and biomass index values for prairie grasses on the 13 plots re-planted in spring 1999 by broadcast seeding. Data are for plots grouped by amendment. See **Figure 1** for legends.

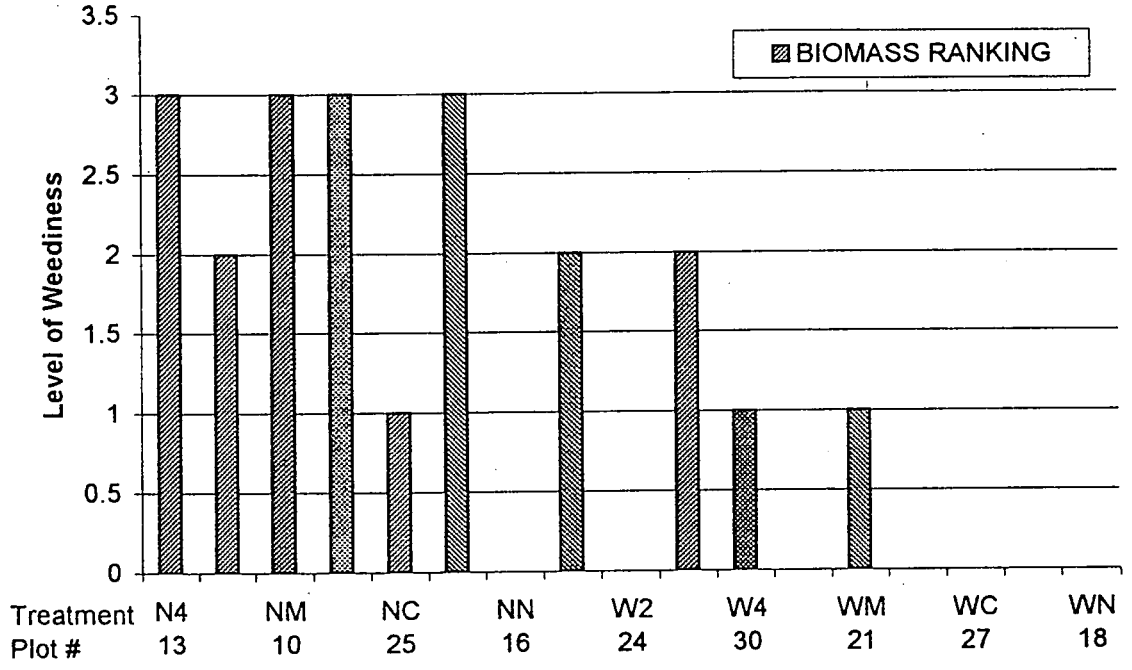


Figure 6. Weediness index measured in June 1999 for plots shown in **Figure 2**. See **Figure 1** for legends.

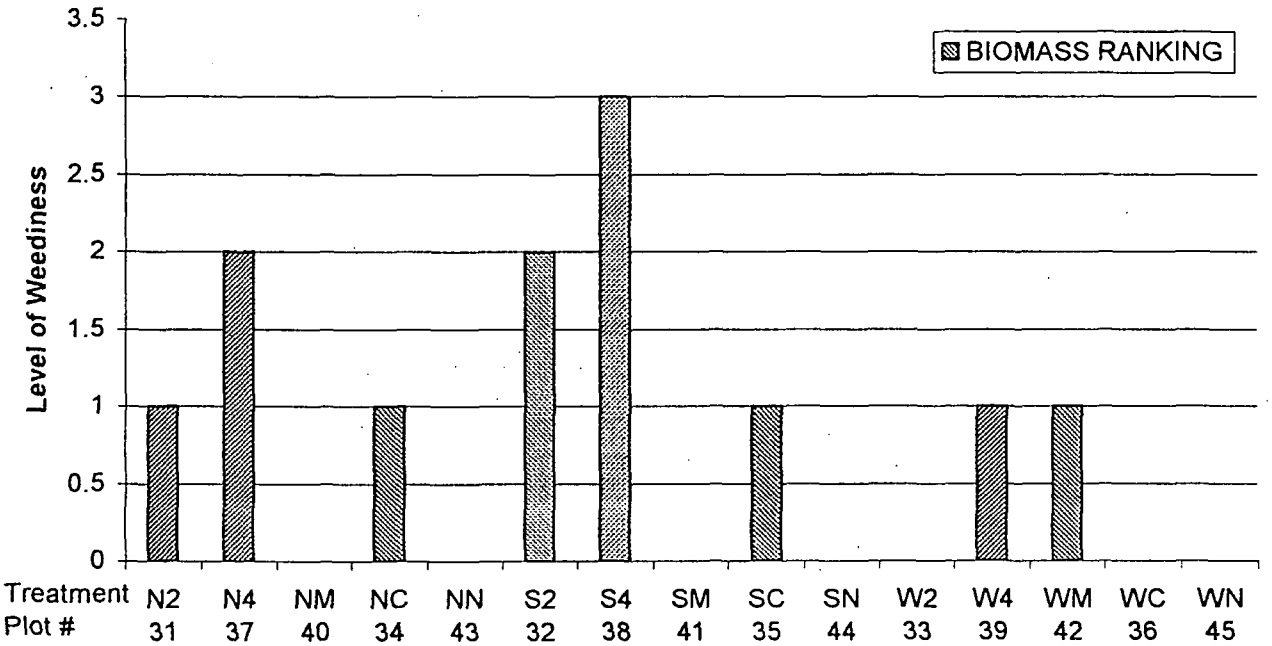


Figure 7. Weediness index measured in June 1999 for plots shown in **Figure 4**. See **Figure 1** for legends.

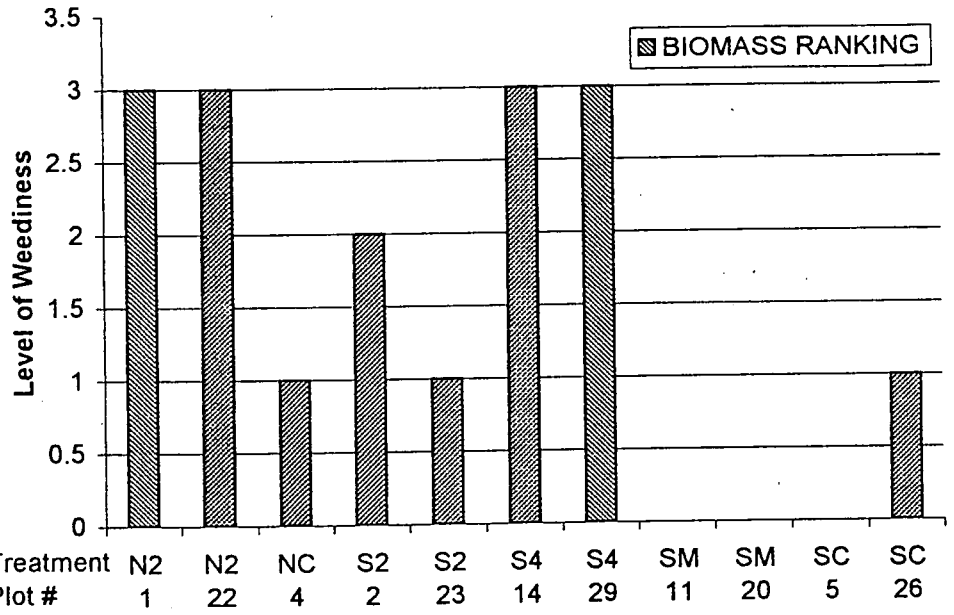


Figure 8. Weediness index measured in June 1999 for plots shown in **Figure 5**. See **Figure 1** for legends.